

Claims

1. A hybrid parabolic reflector phased array antenna, adapted for deployment in space, comprising:

a reflector support structure;

5 a plurality of parabolic reflector cells mounted side by side in an open interior portion of the support structure;

each reflector cell including an RF signal reflector and an array of the RF signal feed elements;

10 each reflector having a flexible reflecting surface and a plurality of elongated edges defining a geometric shape, and including respective corner portions at the intersection of pairs of edges;

respective rigid support members located at the corner portions of the reflector for stiffening the reflector and the elongated edges, and also for providing a support for the array of feed elements;

15 a set of flexible support members extending between the rigid support members of each reflector cell and the respective array of feed elements for positioning the array above the RF signal reflector, and

a mechanism located beneath each of the RF signal reflector for pulling the flexible reflecting surface down to a substantially parabolic shape.

20 2. An antenna structure according to claim 1 wherein the reflector support structure comprises a toroidal support structure.

3. An antenna structure according to claim 1 wherein said plurality of parabolic reflector cells are comprised of super element reflector cells arranged in a planar array.

4. An antenna according to claim 1, and additionally including a support member located at the edges of the reflecting surface to prevent stretching of the reflector along the edges.

5. An antenna according to claim 1 wherein said rigid support members comprise a plurality of elongated posts.

6. An antenna according to claim 1 wherein said set of flexible support members comprises wire support members.

7. An antenna according to claim 1 wherein said mechanism for pulling the reflecting surface down comprises a backup structure including a set of wires and tension cables.

8. An antenna according to claim 1 wherein said flexible reflecting surface comprises a reflector mesh.

9. An antenna according to claim 1 wherein said array of feed elements comprises a planar array of feed elements.

15 10. An antenna according to claim 9 wherein said array of feed elements in each reflector cell is selectively activated in groups of feed elements and wherein said groups are varied in position relative to a focal point of the array to steer a transmitted and/or received beam generated by one or more of the reflector cells.

20 11. An antenna according to claim 10 wherein the array is also steered by steering of the array factor.

12. An antenna according to claim 10 wherein the array is steered to a position where an undesired grating lobe appears for relieving a grating lobe problem.

13. An antenna according to claim 12 wherein the number of feed elements in at least one of the group is also reduced for relieving the gating lobe problem.

14. An antenna according to claim 10 wherein said groups of feed elements are randomly selected so as to be positioned about a predetermined position of the planar array of feed elements for relieving a grating lobe problem.

15. An antenna according to claim 10 wherein said groups of feed elements are gradually shifted from one position to another for relieving a gating lobe position.

16. An antenna according to claim 10 wherein said groups of feed elements are randomly positioned about respective focal points of the planar arrays for relieving a grating lobe problem.

~~17.~~ A method of steering a transmitted and/or received beam of a phased array antenna system including a plurality of super element reflector cells each including a parabolic reflector element and a plurality of feed elements arranged in a planar array and being mounted on a support structure, comprising the steps of:

activating the feed elements of each feed array in selected groups of feed elements at predetermined locations relative to the focal point of the respective array to achieve a coarse scan of the beam; and

steering the array factor of the beam to achieve a fine scan of the beam.

18. A method according to claim 17 and additionally including the step of overlapping feed distributions of said feed array to gradually shift
5 the feed center of the array to steer the beam between nominal beam positions.

19. A method according to claim 17 and additionally including the step of steering the beam via group selection to substantially the exact location of a grating lobe for relieving an undesirable grating lobe problem.

10 20. A method according to claim 19 and additionally including the step of reducing the number of feed elements selected in a group for relieving an undesirable grating lobe problem.

15 21. A method according to claim 17 and additionally including the step of randomly selecting groups of feed elements for positioning said groups about a predetermined position on the feed array for relieving an undesirable grating lobe problem.

22. A method according to claim 17 and additionally including the step of gradually shifting certain groups of feed elements from one position to another for relieving a grating lobe problem.

20 23. A method according to claim 17 and additionally including the step of selecting groups of feed elements so as to be randomly positioned about respective focal points of the planar arrays for relieving a grating lobe problem.

24. A method according to claim 17 and additionally including the step of overlapping feed distributions of said feed array to steer the feed array to the same position as the array factor peak position for relieving an undesirable grating lobe problem.

- 5 25. A method according to claim 17 and additionally including the step of stowing the antenna system in a collapsed state for launch and thereafter deploying the antenna for operation in space.

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